Creating a “Normalized Difference Vegetation Index” (NDVI) image Using MultiSpec

Larry Ryan
161 Morse Hall
OPAL/EOS
University of New Hampshire
Durham, NH 03824

Creating a Normalized Difference Vegetation Index (NDVI) Image using MultiSpec

Introduction: The "Normalized Difference Vegetative Index (NDVI,) is a calculation, based on several spectral bands, of the photosynthetic output (amount of green stuff) in a pixel in a satellite image. It measures, in effect, the amount of green vegetation in an area. In this exercise, you will use MultiSpec's ability to create new "channels" in an image to display the NDVI for an image.

Background: NDVI calculations are based on the principle that actively growing green plants strongly absorb radiation in the visible region of the spectrum (the "PAR," or "Photosynthetically Active Radiation") while strongly reflecting radiation in the Near Infrared region. The concept of vegetative "spectral signatures (patterns)" is based on this principle. Given the following abbreviations:

PAR	Value of Photosynthetically Active Radiation from a pixel
NIR	Value of Near-Infrared Radiation from a pixel

The NDVI for a pixel is calculated from the following formula:

$$NDVI = \frac{NIR - PAR}{NIR + PAR}$$

This formula yields a value that ranges from -1 (usually water) to +1 (strongest vegetative growth.)

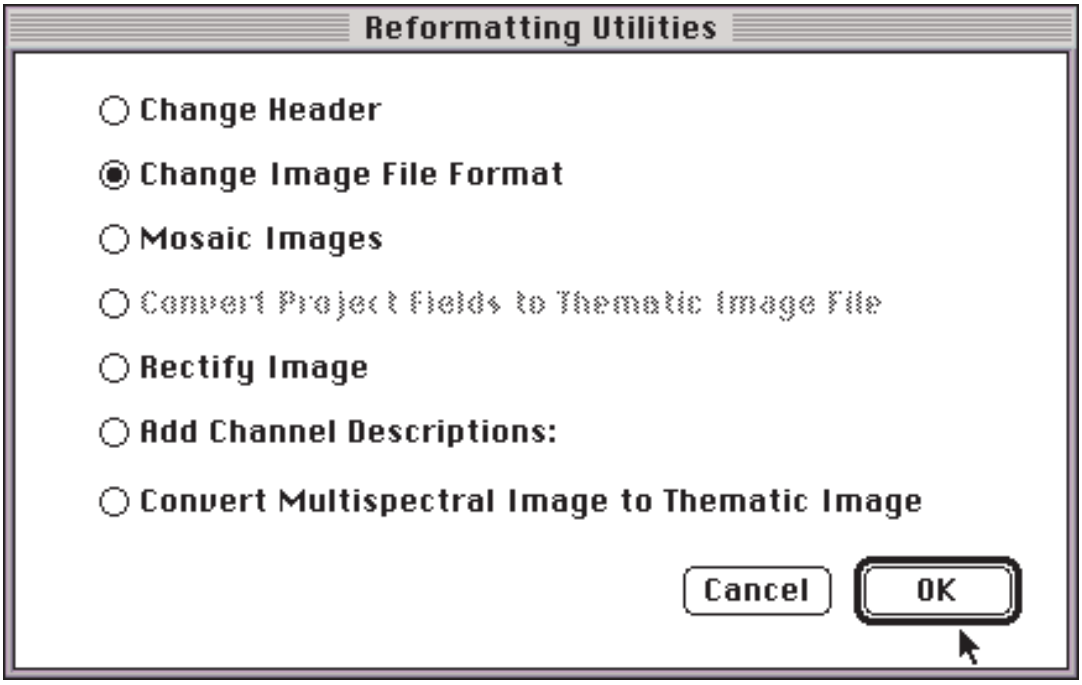
In this exercise, we will make the modification of using only the Red image band instead of the whole range of PAR. Thus, our formula will be:

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

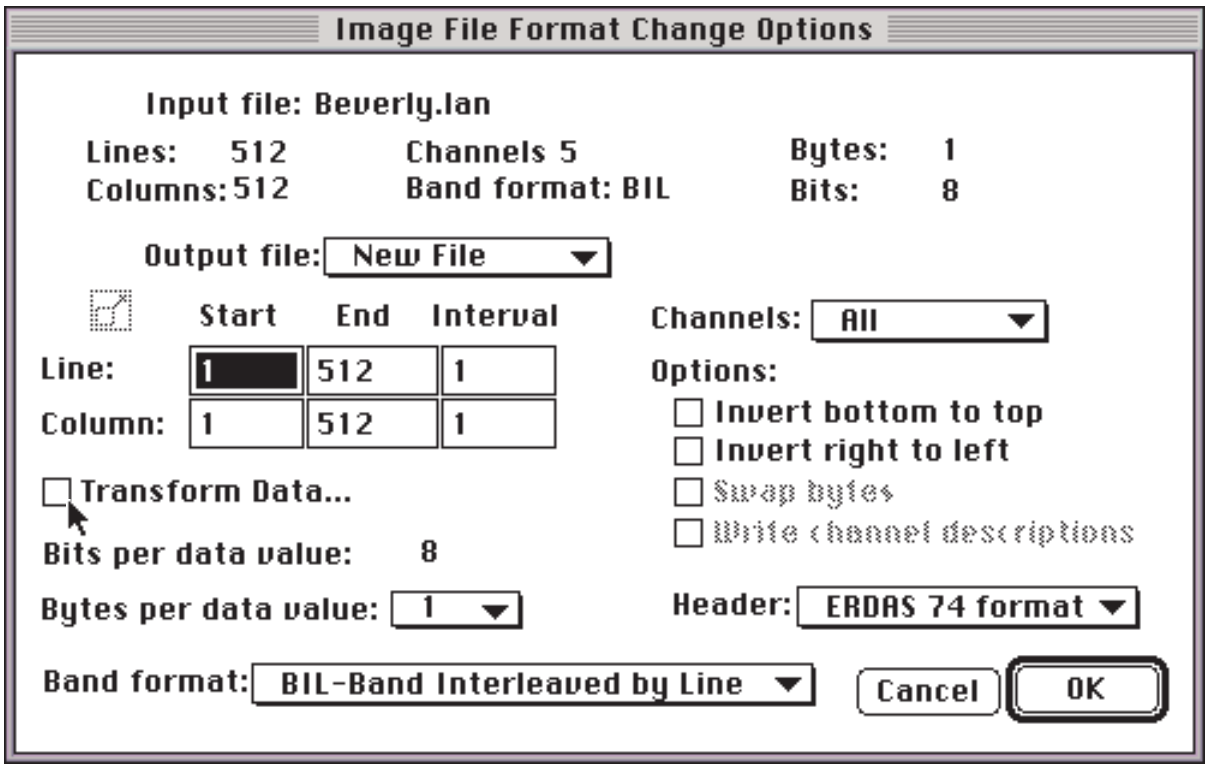
Creating the New Channel

- Launch MultiSpec and **Open** the image you wish to analyze. **Your image must contain the data from both the Red and Near-Infrared channels** of the satellite image you wish to analyze. The procedure may be used with images from AVHRR, Landsat MSS and TM, and SPOT sensors.

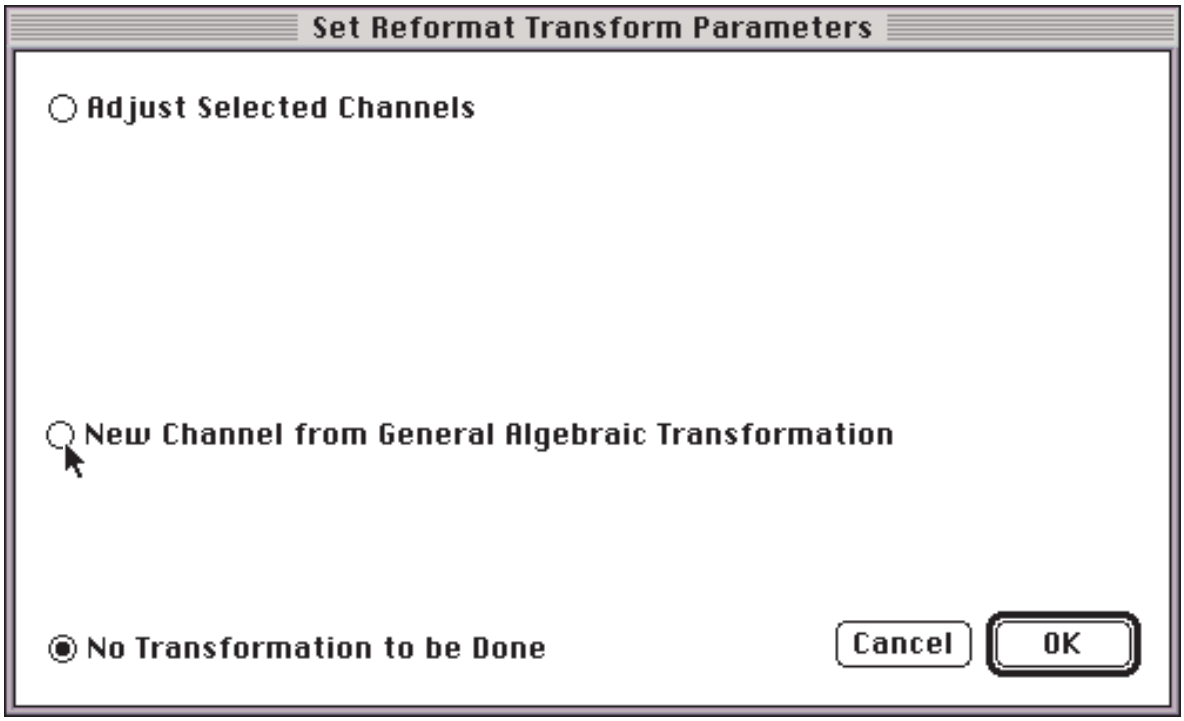
- From the **Processor** menu in the main menu bar, select **Reformat**. The window shown below opens:



- Click **OK**.
- The **Image File Format Change Options** window opens, as shown on the next page.



- Note that, while the "**Input File**:" entry in this tutorial contains "**Beverly.lan**," in your your work, the entry will contain the name of the file you are using.
- Click in the box in front of "**Transform Data**."
- The following "**Set Reformat Transform Parameters**" window appears immediately.



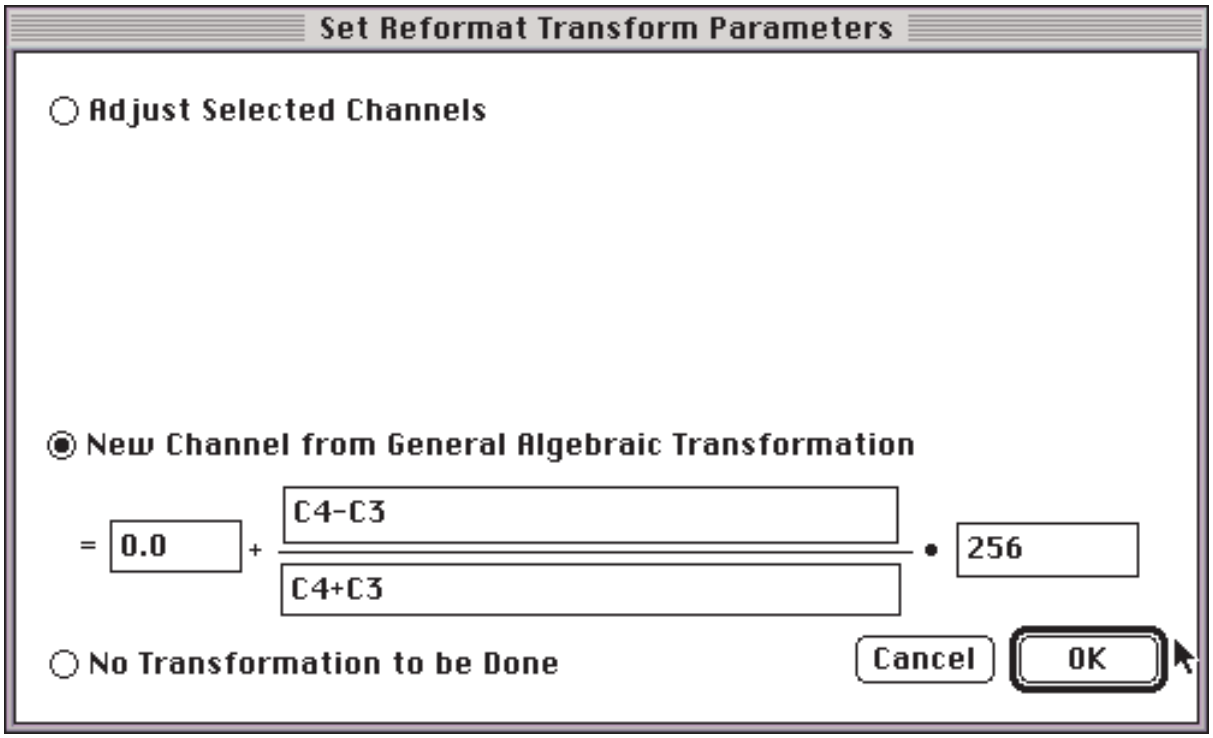
- Click the button marked "**New Channel from General Algebraic Transformation**."

- The window below appears. It is in this window that we tell the system how we wish to create a new channel from the data we already have.

- In this window, enter the values shown below in each space. Use the **TAB** key to move from entry space to entry space.

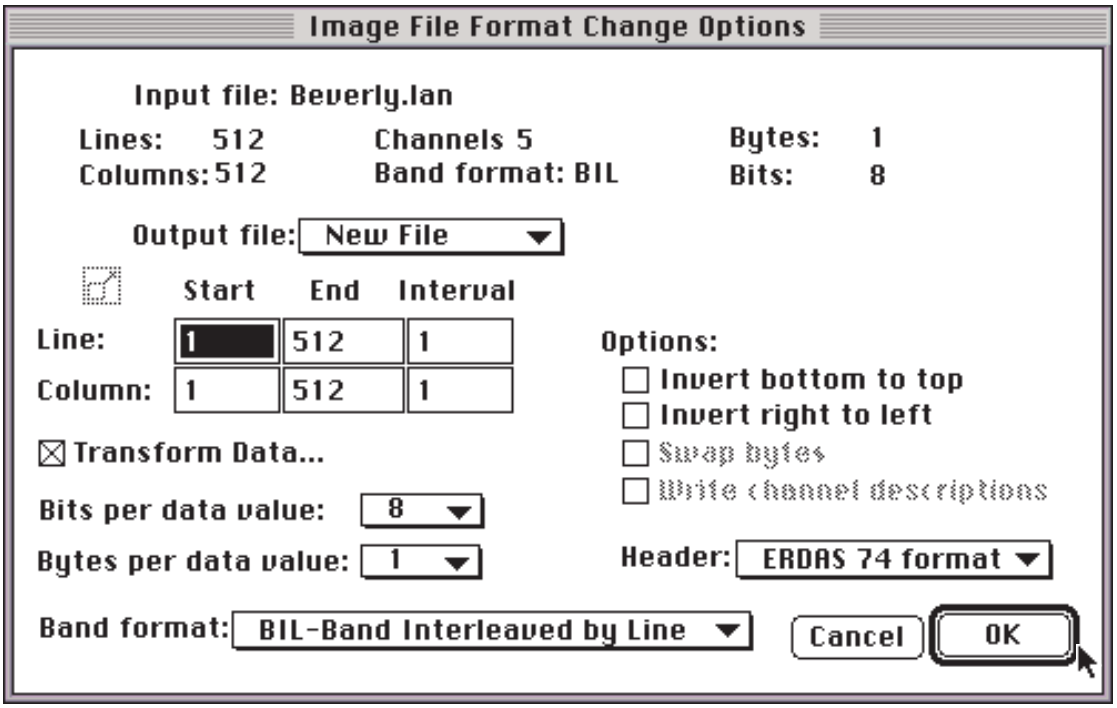
NOTE: This tutorial assumes that you are using a Landsat TM (30 m resolution) image, in which the **Red band is channel 3 (C3) and the near-infrared band is channel 4 (C4)**. If you have some other combination of bands, specify your specific channel numbers for the Red and NIR bands in your image.

NOTE: In the chanel designations (C3, etc) the "C" must be upper case.



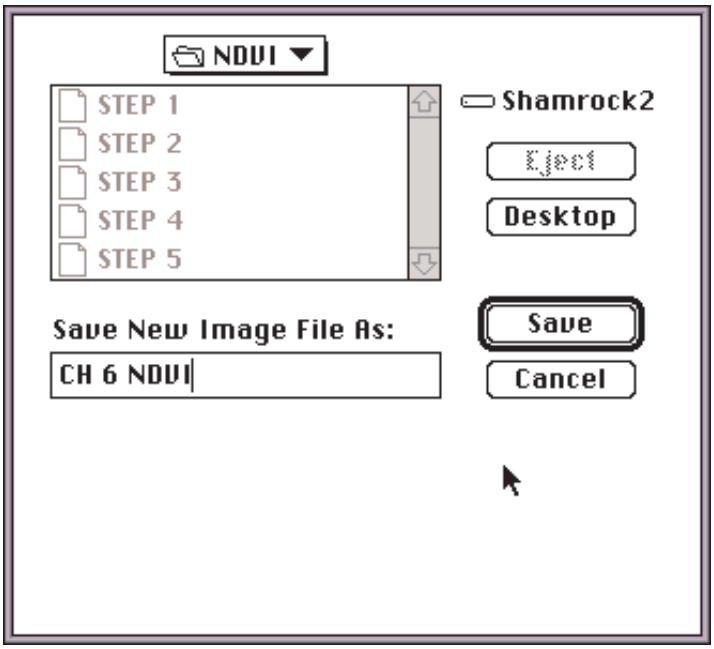
The Math: The equation above creates a new channel (band) for the image, whose contents, pixel by pixel, are the NDVI values for the image. However, since NDVI normally has a maximum value of 1 (Use MultiSpec to find some channel 3 and 4 values from your image and experiment with the equation to see how this occurs), and other pixel values in an 8-bit satellite image range from 0 - 255, we must multiply the NDVI by 256 so that channel values will be compatible with the other channels in the image.

- Once you are sure your formula entries are correct, clike 0K. The "**Image File Format Change Options**" screen, shown below, appears.

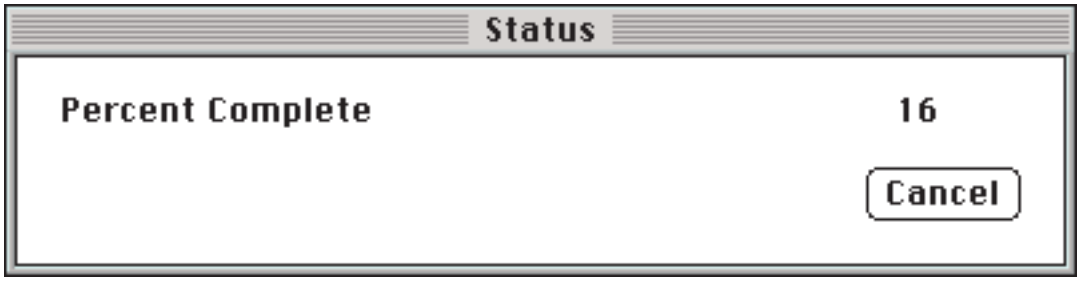


- Click **0K**

¥ The standard Macintosh "**Save File**" dialog box appears. Name your new file "**CH 6 NDVI**" and save it to the same directory (folder) that contains your original image.



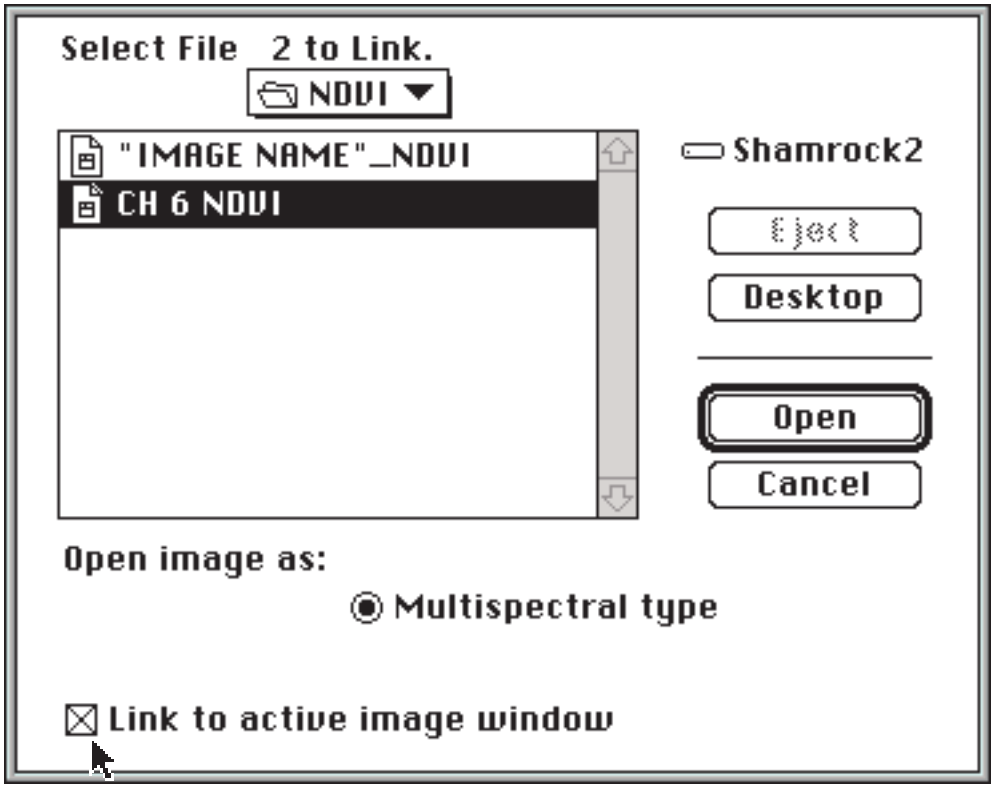
- The "**Status**" window appears, tracking the progress of the production of the new channel.
- When this window closes, you will be returned to the original image window.
- **Do not close this image window.**



The new channel, containing the NDVI values, has been created and saved. In the next section, you will add this channel to the original image, and then display this channel.

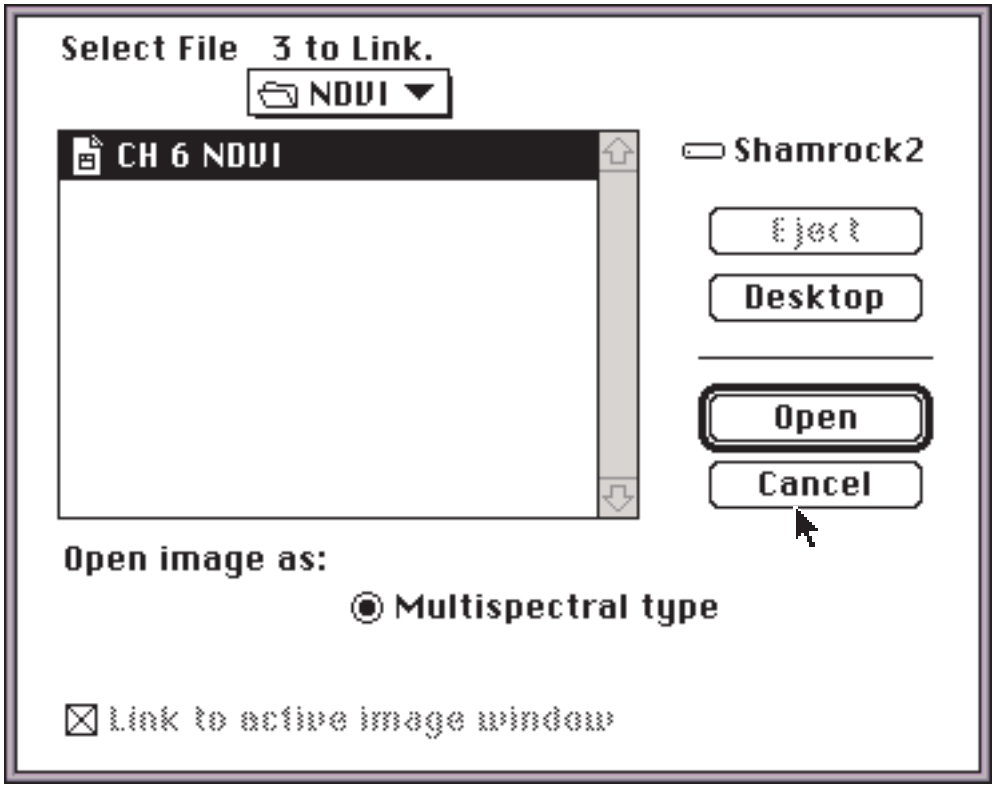
Adding the NDVI Channel to the Image

- With the original image still open, select **Open Imge** from the **File** menu.
- In the **Open Image** window, shown below, click in the "**Link to active image window**" box, and select the "**CH 6 NDVI**" image you created earlier.



- Click **Open**

- The same window (almost) opens again, as shown below.

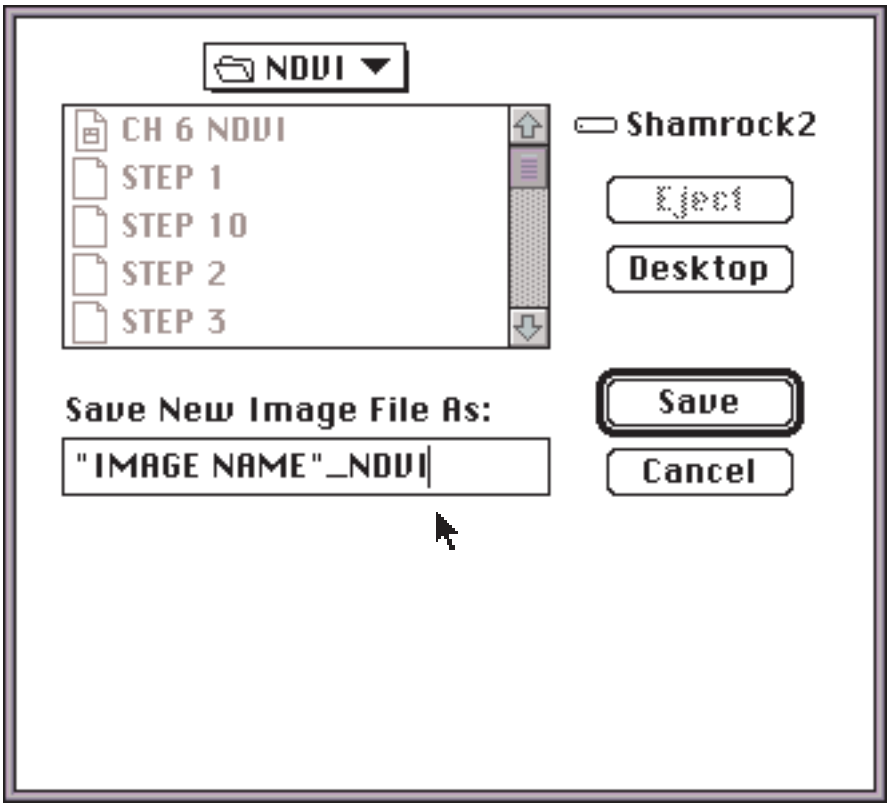


- This time, the window says "**Select File 3 to Link**." The system is asking is you have any more files to link to the active image. **PRESS CANCEL**.

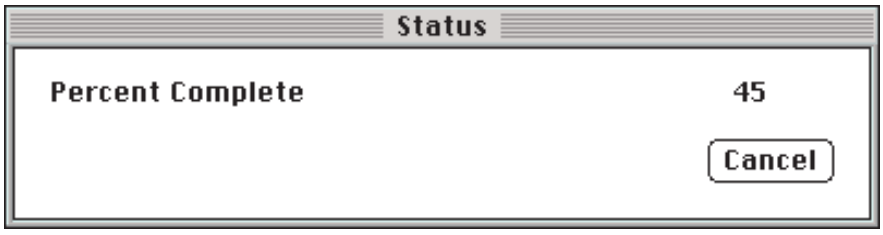
- Again, you are returned to the active image. It does not look any different, but a new channel has been added. The next step is to save this new image with a different name than the original.

Saving the New Image

- From the Processor menu in the main menu bar, select Reformat.
- **PRESS RETURN TWICE**.
- This brings you to the "**Save New Image File As**:" dialog box, as shown below.



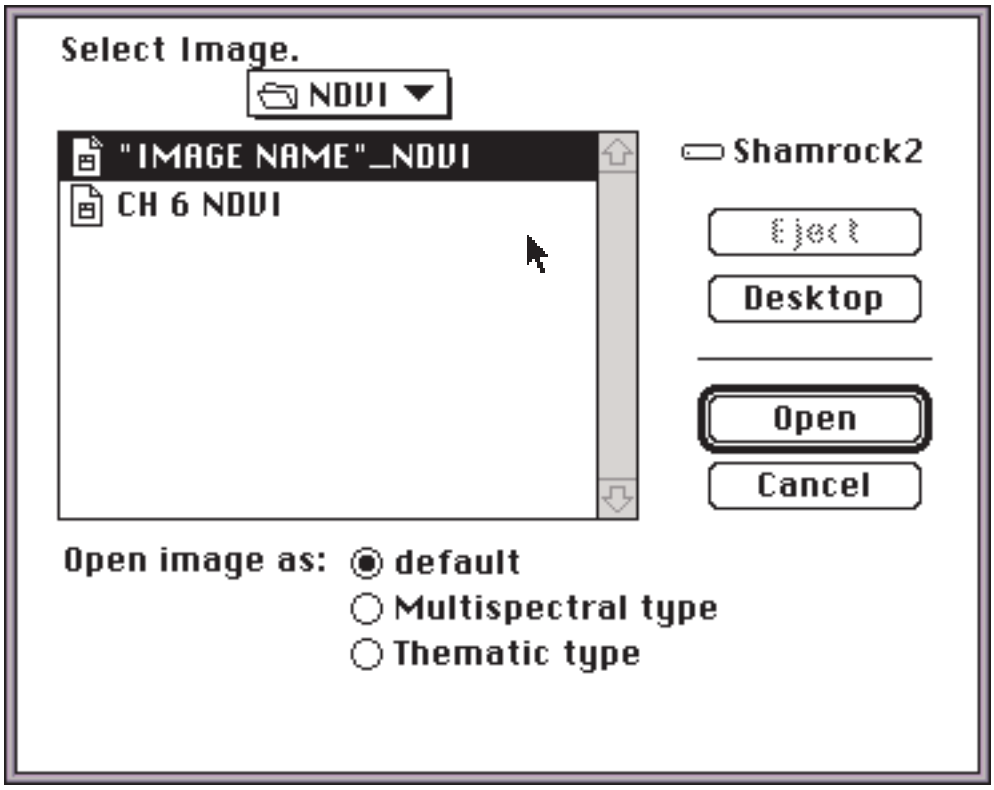
- Before saving the file, append the letters **NDVI** to the file name, so that you know that this version contains your NDVI data.
- Click "**Save**."
- A status box shows the progress of this "save."



- Your image has now been saved with the new band appended. In the next sections, you will examine this new channel.

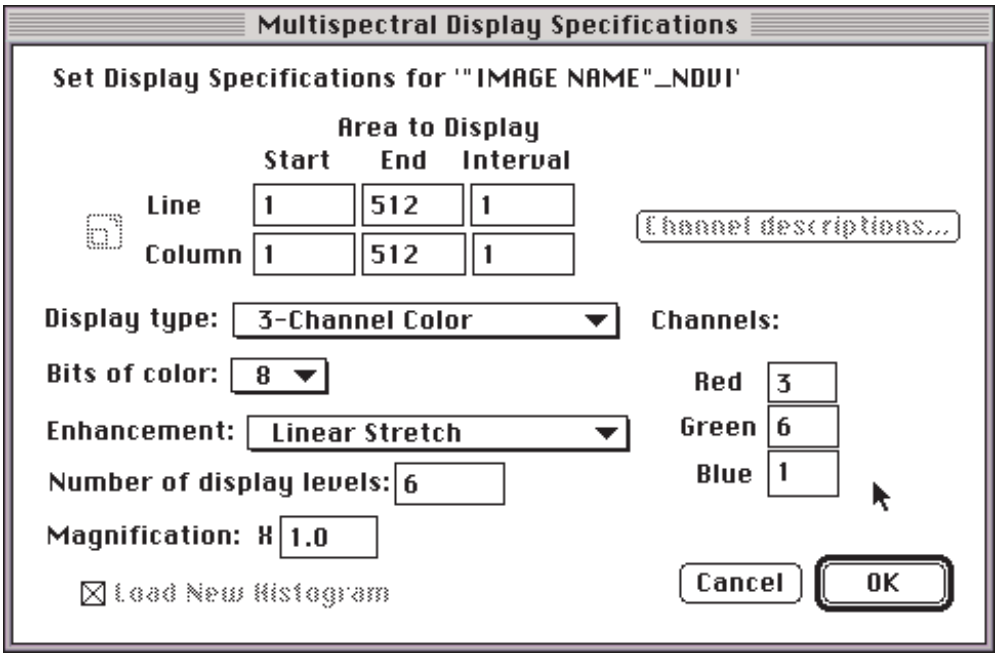
Displaying the NDVI Channel

- You may close the current image window or, if you wish, leave it open for comparison to the NDVI channel.
- From the **File** menu, select **Open Image**. The **Open Image** dialog box opens, as shown below.



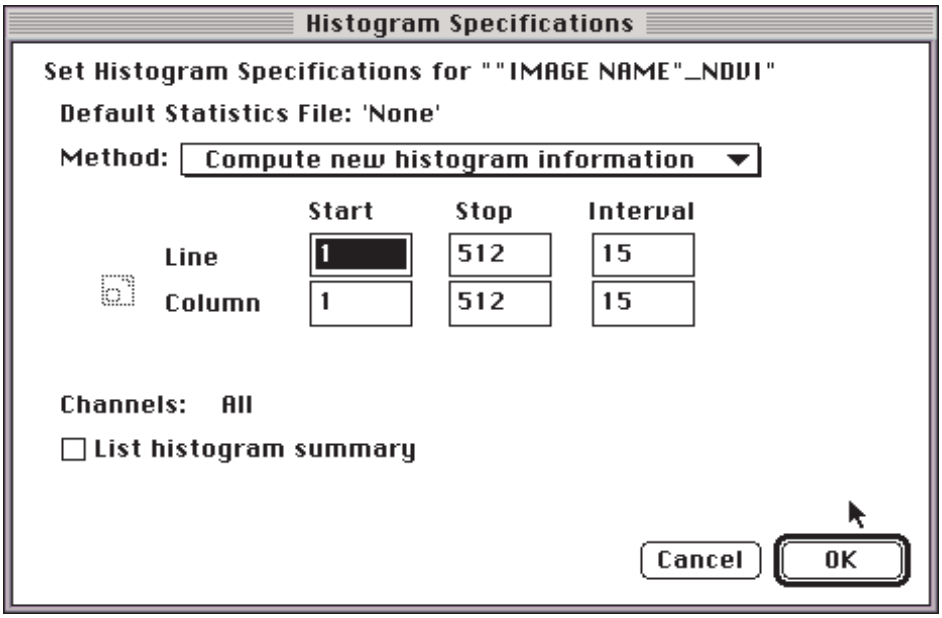
- Select your **NDVI** image and click **Open**.

- In the "**Set Multispectral Display Specification**" window, enter the channel selections shown below. Notice that the **Green** band has the new NDVI channel assigned to it. This means that pixels with high NDVI (meaning strong vegetative growth) will appear green, while pixels with low NDVI (non-vegetated) will appear in the reds and blues.

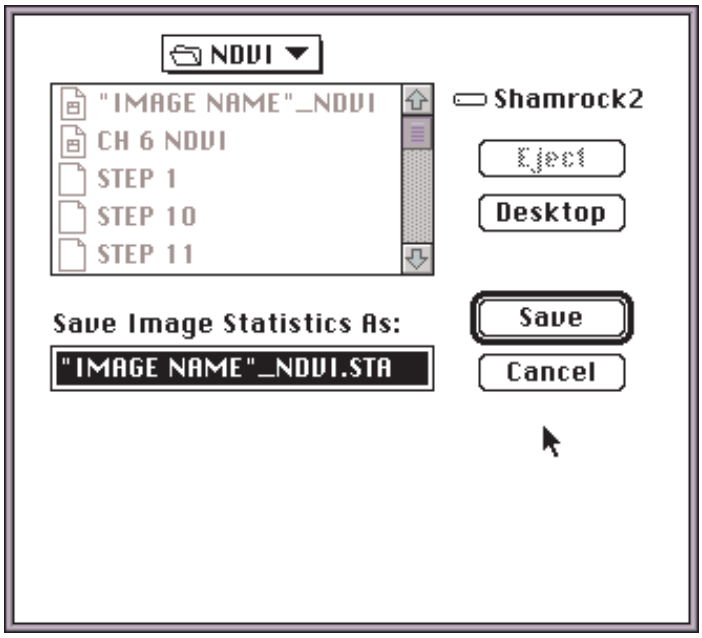


- Click **0K**

- Because this is now a new image, MultiSpec must build a new histogram file for this image. This file contains the statistics for the image. When you click 0K, the "**Histogram Specification**s" window, below, will appear.



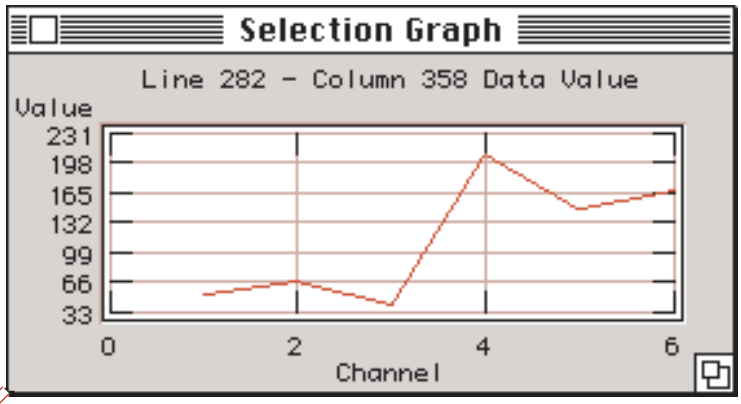
- Click **OK**.
- In the dialog box that follows, notice that the new file carries the extension "**.STA**" This is the familiar statistics file you see with most MultiSpec images.
- Click **Save** to save this file.

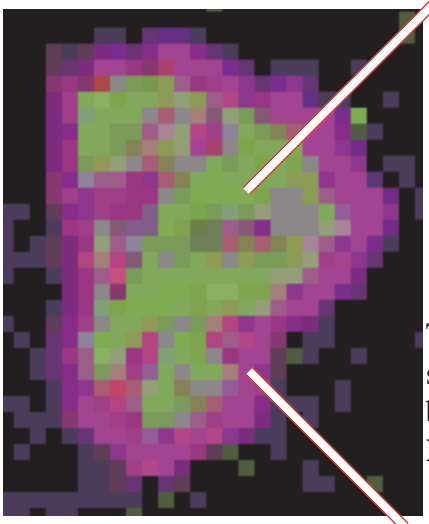


- Your image now opens displaying the NDVI data on the green gun of your monitor. Areas that are brightest green have the highest NDVI values, and the blue/red/purple areas have the lowest NDVI.
- You may use the **New Selection Graph** selection from the **Options** menu to display the spectral signatures of pixels. If you are using the image of an area with which you are familair, notice that strongly vegetated areas have high channel 6 (the NDVI channel) readings, while unvegetated areas have very low values for channel 6.

NDVI Examples

• The diagrams below show spectral signatures from a small, wooded island with a well-defined rocky outline with beaches.





The spectral signature above shows an area of vegetation, as indicated by the high value for channel 6, the NDVI channel. Note the bright green color for this pixel.

The spectral signature below, from the beach/rocks surrounding the island, indicates no vegetation, as shown by the very low reading for channel 6, the NDVI channel. Note the purple color for this pixel.